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ABSTRACT

This discussion of computers and their place in the field of engineering technology begins with an outline of the historical development and significance of computers, tracing advancements from the first generation of computers, which began to be produced in 1946, to current third-generation models; reviewing the current state of the art in computer technology; and projecting likely developments in the field. Next, the educational implications of computer technology are examined in terms of computer-assisted and computer-managed instruction and preparation of students to use computers in their chosen career. Next, a discussion of the field of engineering technology defines and sets forth the scope of the discipline, considers industrial occupational patterns, and looks at computer use in industrial technical areas for standard and special problem solving, data gathering and analysis, process control, and design and manufacturing support. Then, the paper focuses on the computer skills necessary in engineering occupations and on relevant equipment and software considerations. After a section on the effects of changes in computer technology on engineering faculty and on methods of updating faculty skills, such as short courses, workshops, and return to industry, the paper touches upon issues of curriculum development. The paper includes charts, illustrations, and a computer literacy questionnaire and answer key. (HB)

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ENGINEERING TECHNOLOGIES AND THE ROLE OF THE COMPUTER

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TABLE OF CONTENTS

Outline of Presentation	1
Title Page	2
Introduction	3
Computer Literacy Test	9
Historical Development	12
Educational Implications	29
Engineering Technology	32
Computers in Engineering Technology Education	37
The Faculty	42
Curriculum Development	46
Summary	50

OUTLINE

ENGINEERING TECHNOLOGY & THE ROIE OF COMPUTERS

I. Historical Development and Significance of Computers

- A. Original development and applications
- B. The generations of computers
- C. Current State of the Art
- D. Future developments

II. Educational Implications of Computers

- A. Computer assisted instruction
- B. Computer managed instruction
- C. Job requirements/application
- D. Organizational concepts

III. Engineering Technology

- A. Definition and scope
- B. Training orientation
- C. Industrial occupational patterns
- D. Computers in inductrial technical fields

IV. What kind and how much computers in Engineering Technology

- A. Basic skills - computer literacy
- B. Problem solving application
- C. Main frames, minis and micros
- D. Software considerations

V. The Faculty

- A. Knowledge and ability
- B. Acceptance of concept
- C. Developing skills
- D. Development of curriculum

VI. Summary

- A. Where we were, are and will be
- B. Key issues hardware, software and skinware

PRESENTATION

"ENGINEERING TECHNOLOGIES AND THE ROLE OF THE COMPUTER"

Presented at the NISOD Conference
University of Texas at Austin

May, 1982

By:
Lester W. Reed, Jr., Ph.D.
Vice President for Education
Greenville Technical College
South Carolina

SLIDE 1

GOOD MORNING! MY NAME IS LES REED AND I AM THE VICE PRESIDENT FOR EDUCATION AT GREENVILLE TECHNICAL COLLEGE IN SOUTH CAROLINA. OUR SCHOOL - ALTHOUGH CALLED A TECHNICAL COLLEGE - IS A COMPREHENSIVE COMMUNITY COLLEGE AND EMBRACES BOTH TERMINAL OCCUPATIONAL PROGRAMS AND COLLEGE TRANSFER PROGRAMS. IN ADDITION, WE HAVE A FULL ARRAY OF CONTINUING EDUCATION OFFERINGS INCLUDING COMMUNITY SERVICE ACTIVITIES. THE COLLEGE HAS APPROXIMATELY 5,000 CREDIT FTE'S AND APPROXIMATELY 25,000 INDIVIDUALS WHO TAKE PART IN SOME TYPE OF CONTINUING EDUCATION ACTIVITY. LAST YEAR OUR OCCUPATIONAL ADVANCEMENT CONTINUING EDUCATION PRODUCED 400,000 CONTACT HOURS. GREENVILLE ITSELF IS IN THE NORTHWEST CORNER OF SOUTH CAROLINA AND IS BASICALLY AN INDUSTRIAL AREA ENCOMPASSING TEXTILE INDUSTRIES AND, MORE RECENTLY, METALWORKING AND ENGINEERING FIRMS. IN ADDITION, THERE ARE LARGE PLANTS OF MICHELIN TIRE, PLASTIC FIRMS SUCH AS CRYOVAC AND TEXIZE CHEMICAL PLANTS. AS A RESULT, THE COLLEGE IS ACTIVELY INVOLVED IN TECHNOLOGICALLY BASED TRAINING AND HAS A FULL ARRAY OF ENGINEERING AND INDUSTRIAL PROGRAMS. THESE ENGINEERING AND INDUSTRIAL PROGRAMS ARE THE BASIS FOR TODAY'S PRESENTATION.

GREENVILLE

TECHNICAL

COLLEGE

SLIDE 1

ENGINEERING TECHNOLOGIES

AND THE

ROLE OF THE COMPUTER

SLIDE 2

SLIDE 2

AS YOU CAN SEE FROM THE TITLE, I WISH TO DISCUSS WITH YOU ENGINEERING TECHNOLOGIES AND THE ROLE OF THE COMPUTER IN THESE TECHNOLOGIES. I WILL BE TOUCHING ON BOTH THE ROLE OF THE COMPUTER IN THE WORK ENVIRONMENT AS WELL AS THE INSTRUCTIONAL ENVIRONMENT. THE MAJOR OBJECTIVE OF THE PRESENTATION IS TO ILLUSTRATE WHERE COMPUTER TECHNOLOGY HAS IMPACTED WHAT ARE TYPICALLY COMMUNITY COLLEGE TERMINAL DEGREE PROGRAMS IN ENGINEERING AND INDUSTRIAL TECHNOLOGY. I HOPE TO SHOW HOW THIS IMPACT OF COMPUTER TECHNOLOGY HAS CHANGED OUR INSTRUCTIONAL REQUIREMENTS AND MOST PARTICULARLY HOW IT REQUIRES DIFFERENT APPROACHES TO STAFF AND FACULTY DEVELOPMENT.

SLIDE 3

I THINK WE ARE ALL FAMILIAR WITH THE SEPARATE VOCABULARY THAT HAS GROWN UP ABOUT THE AREA OF COMPUTER TECHNOLOGY. COMPUTER JARGON IS EVERYWHERE. WE SEE IT IN MAGAZINES, NEWSPAPERS AND TEXTBOOKS. BEFORE I GET INTO MY PRESENTATION, I THOUGHT I WOULD GIVE YOU A CHANCE TO SEE HOW MUCH OF THIS COMPUTER JARGON HAS RUBBED OFF. FOR THOSE WHO ARE HIGHLY COMPUTER LITERATE, THE LITTLE TEST I HAVE DEVELOPED WILL BE NO CHALLENGE AT ALL. FOR OTHERS, IT MIGHT TURN OUT TO BE QUITE INTERESTING. IF YOU WILL TURN TO THE FOLDERS, YOU WILL FIND IN THEM A COMPUTER LITERACY TEST. LET'S TAKE A COUPLE OF MINUTES AND SEE HOW WELL YOU CAN DO ON THIS TEST.

A AND B

THE ANSWERS TO THE COMPUTER LITERACY TEST ARE SHOWN ON THE FOLLOWING TWO SLIDES. ADDITIONALLY, I AM PASSING OUT A HANDOUT WHICH SUMMARIZES THESE ANSWERS. LET US GO OVER THE QUESTIONS AND THEIR ANSWERS. (DISCUSS RESPONSES WITH AUDIENCE)

SLIDE 3

COMPUTER JARGON

CHIP
CPU
ROM
CMA
FLAG
PROM
LOOP
IC
BINARY
BAUD
BIT
BUG
BYTE
LSI
RAM
GATE
ALU
USRT
ASSEMBLER

COMPUTER LITERACY TEST

A. DEFINE THE FOLLOWING TERMS:

1. Field: _____

_____

2. Bug: _____

_____

3. Assembler: _____

_____

4. Gate: _____

_____

5. Loop: _____

_____

6. Binary: _____

_____

7. Chip: _____

_____

B. List the text of the following acronyms:

1. ROM _____ _____ _____
2. IC _____ _____
3. USRT _____ _____ _____ _____
4. ALU _____ _____ _____
5. CPU _____ _____ _____
6. PROM _____ _____ _____ _____
7. RAM _____ _____ _____

(OVER)

C. List Three major computer languages and their general areas of application:

1. _____: _____

_____

_____

2. _____: _____

_____

_____

3. _____: _____

_____

_____

COMPUTER LITERACY
TEST ANSWERS

PART A:

1. Field: a meaningful item of data
2. Bug: an error in a computer program
3. Assembler: a computer program that translates symbolic instructions to binary equivalents (ie: processes a machine-language program) or a symbolic programming language
4. Gate: a circuit with two or more inputs which control the output
5. Loop: a sequence of instructions written only once but executed until a predefined condition is met
6. Binary: a base 2 numbering system using the digits 0 and 1
7. Chip: active and passive elements of an electronic integrated circuit on a piece of semiconductive material

PART B:

1. ROM: Read Only Memory
2. IC: Integrated Circuit
3. USRT: Universal Synchronous Receiver/Transmitter
4. ALU: Arithemetic Logic Unit
5. CPU: Central Processing Unit
6. PROM: Programmable Read Only Memory
7. RAM: Random Access Memory

PART C:

ASSEMBLER OR ASSEMBLY: Symbolic language closely related to the "machine language" of the system used to maximize efficiency of a computer program

FORTRAN: FORmula TRANslation language- a symbolic language used generally in science, engineering and mathematical applications

COBOL: COmmon Business Oriented Language: An "English like" language used in business oriented programs.

BASIC: Beginners All-purpose Instructional Codes. An "English like" language used in personal computers, and academic applications

RPG: Report Program Generator. A simplified computer language used to generate business reports

PASCAL: A simplified language used to increase the ability of users to combine scientific and business processing of large amounts of data

PL/1: Programming Language/1: A high level language combining COBAL and FORTRAN features

SLIDE 4

NOW THAT WE HAVE ESTABLISHED WHERE WE ARE IN REGARD TO COMPUTER LITERACY, LET US TAKE A LOOK AT COMPUTERS AND WHAT HAS OCCURRED IN OUR SOCIETY OVER THE LAST 25 YEARS. HISTORICALLY, COMPUTER DEVICES HAVE BEEN USED FOR MATHEMATICAL COMPUTATIONS AND DATA STORAGE. EARLY WITHIN THE DEVELOPMENT OF CIVILIZATIONS, VARIOUS TYPES OF PERMANENT RECORDS WERE DEVELOPED IN WHICH DATA GENERALLY CONCERNING FINANCIAL TRANSACTIONS WERE COMPILED. EVENTUALLY, A DOUBLE ENTRY BOOKKEEPING SYSTEM WAS DEVELOPED DURING THE 14TH CENTURY AND THIS SYSTEM COUPLED WITH THE ARABIC NUMBERING SYSTEM FORMED THE BASIS FOR MUCH OF THE RECORDKEEPING AND ASSOCIATED MATHEMATICS USED THROUGHOUT SOCIETY. NOT ONLY WERE RECORDS KEPT ON PAPER BUT VARIOUS OTHER STORAGE DEVICES SUCH AS THE 15TH CENTURY ENGLISH TALLY STICK WERE DEVISED IN ORDER TO GIVE PERMANECY TO THE INFORMATION NEEDED FOR THE DAILY BUSINESS OF SOCIETY. THE COMPLEXITY OF MATHEMATICAL COMPUTATIONS AND DATA STORAGE LED TO MANY EFFORTS TO SIMPLIFY THE PROCESS. THE EARLIEST DEVICE USED IN COMPUTING CAME FROM ANCIENT BABYLON AND REMAINS IN USE TODAY IN EASTERN CULTURES. THIS IS THE ABACUS, A DEVICE OF BEADS WHICH ARE MOVED AS NUMBERS ACCUMULATE. IN ADDITION, OTHER MECHANICAL DEVICES WERE INVENTED SUCH AS BABBAGES' DIFFERENCE ENGINE WHICH WAS DESIGNED TO SQUARE NUMBERS AND GIVE THE DIFFERENCES BETWEEN EACH SQUARE AND IN TURN SQUARE THE DIFFERENCE. THIS MACHINE WAS VERY USEFUL IN COMPUTING TABLES TO BE USED IN MATHEMATICAL SCIENTIFIC ACTIVITIES. THERE WERE ADDITIONALLY OTHER TYPES OF MECHANICAL ELECTRICAL DEVICES COMING ON THE SCENE IN THE '30'S. THESE CONSISTED OF SUCH ITEMS AS ADDING MACHINES AND CALCULATORS. ADDITIONALLY, PUNCH CARDS AND ACCOUNTING MACHINES CAME ON THE SCENE.

ALTHOUGH LATER MODELS OF THE ACCOUNTING MACHINE ARE STILL IN USE, THESE PRIMARILY ELECTRO[redacted]MECHANICAL DEVICES REQUIRE MOVEMENT OF VARIOUS LEVERS BY ELECTRICAL FORCE TO DO THE COMPUTATION FOR POSTING. THE EARLIEST PUNCH CARD MACHINE SORTED BASED ON SPINDLES WHICH WENT THROUGH THE VARIOUS APPROPRIATE HOLES. ALL OF THESE ACTIVITIES TENDED TO MAKE THE PROCESS OF MATHEMATICAL COMPUTATION AND DATA STORAGE SIMPLER AND MORE EFFICIENT.

1

COMPUTING DEVICES

- HISTORICAL FUNCTIONS
  - MATHEMATICAL COMPUTATIONS
  - DATA STORAGE

- MECHANICAL & ELECTRO-MECHANICAL DEVICES
  - ABACUS & DIFFERENCE ENGINE
  - ADDING MACHINES
  - PUNCH-CARD MACHINES
  - ACCOUNTING MACHINES

14

SLIDE 4

Computers Arrive - Generation I

- 1946 - ENIAC ARRIVES
    - Hard wired to 6,000 switches
    - 30 Tons & 1,500 square feet
    - 18,000 vacuum tubes
    - calculating speed = 3 milliseconds
    - Ran until 1955

- 1951 - UNIVAC I Goes Commercial

- Magnetic tape storage & symbolic languages

- Business & scientific application

15-

SLIDE 5

SLIDE 5

TRUE COMPUTERS FOR COMMERCIAL APPLICATION DID NOT ARRIVE ON THE SCENE UNTIL 1946. ENIAC, WHICH STANDS FOR ELECTRONIC NUMERICAL INTEGRATOR AND CALCULATOR, WAS THE FIRST COMMERCIALLY USABLE TRUE COMPUTER AND ESTABLISHED THE FIRST GENERATION OF HARDWARE. THIS COMPUTER CONSISTED OF SOME 6,000 SWITCHES WHICH WERE HARD WIRED - THAT MEANS ACTUALLY CONNECTED BY ELECTRICAL WIRES WHICH HAVE TO BE RECONNECTED IN A DFFERENT CONFIGURATION IN ORDER TO ALTER THE PROGRAM. ENIAC WEIGHED 30 TONS AND OCCUPIED 1500 SQUARE FEET OF SPACE. IT CONSISTED OF 18,000 VACUUM TUBES AND ALL FIRST GENERATION COMPUTERS WERE BASED ON VACUUM TUBE TECHNOLOGY WHICH WAS A MAJOR LIMITATION BOTH ENVIRONMENTALLY AND IN TERMS OF REALIBILITY. IF YOU RECALL THE OLD VACUUM TUBE TV AND THE NUMBER OF TIMES YOU HAD TO REPLACE TUBES, YOU'LL UNDERSTAND WHY GENERATION I COMPUTERS WERE LESS THAN TOTALLY RELIABLE. ENIAC COULD CALCULATE AT A RATHER RAPID RATE, ONE COMPUTATION TAKING SOME 3 MILLISECONDS OR 3 ONE-THOUSANDTHS OF A SECOND. IT SURVIVED UNTIL 1955. OF COURSE, IMPROVEMENTS WERE BEING MADE ALL ALONG AND IN 1951 UNIVAC WENT COMMERCIAL. UNIVAC WHICH WAS THE UNIVERSAL AUTOMATIC COMPUTER WAS SOLD TO MANY USERS AND HAD SEVERAL SERIES OF MODELS. ADDITIONALLY, DURING GENERATION I, MAGNETIC TAPES STORAGE AND SYMBOLIC LANGUAGES WERE DEVELOPED IN ORDER TO FACILITATE AND MAXIMIZE THE USE OF COMPUTING DEVICES. HOWEVER, DUE TO THE COST AND BULK AND COMPLEXITY OF THESE ITEMS, THEIR APPLICATION WAS PRIMARILY TO PROCESS LARGE AMOUNTS OF DATA IN BUSINESS AND SCIENTIFIC APPLICATION. IN SHORT, THEY WERE LARGE MAINFRAMES DEDICATED TO NUMBER CRUNCHING. (SLIDE 5-A) THIS SLIDE SHOWS THE ENIAC COMPUTER. TRY TO IMAGINE HOW THIS LOOKS IN COMPARISON TO THE COMPUTERS YOU SEE TODAY.

SLIDE 6

By 1958, some 12 years after the start of commercial computers, the second generation came on the scene. Although all transistor technology was in the laboratories during the early fifties, it was not until IBM's system 1400 came out that comercially available all transistor computers were placed in general use. Transistors and electronic components which replaces vacuum tubes dramatically increased the realibility of computing devices and correspondingly reduced costs through the lesser expensive manufacturing process of building a transistor versus a vacuum tube. In addition, transistors made available increased internal storage and increased processing speed of computers. Additionally, during the late 50's and early 60's, developments such as external storage, creation of magnetic disks with random access to data and more efficient programming languages and software increased the usability of computers. However, the second generation computer was still primarily a large application business and scientific device. Second generation computers were still mainly large central processors used for number crunching.

SLIDE 6

TRANSISTORS IMPROVE PERFORMANCE - GENERATION II

- 1958 - IBM PRODUCES "ALL TRANSISTOR" COMPUTERS
  - RELIABILITY INCREASED - COST DECREASED
  - INCREASED INTERNAL STORAGE
  - INCREASED PROCESSING SPEED

- ADDITIONAL DEVELOPMENTS
  - EXTERNAL STORAGE
  - MAGNETIC DISKS & RANDOM ACCESS
  - MORE EFFICIENT "LANGUAGES" AND SOFTWARE

- STILL BUSINESS & SCIENTIFIC APPLICATION

Solid State Comes of Age - Generation III

- 1964 - IBM System/360 Solid State Technology Computers
  - Near absolute reliability
  - High speed
  - Increased capacity - decreased size
  - Simultaneous operations
  - Expandability

- Expansion to all aspects of human endeavors

61

SLIDE 7

SLIDE 7

ONLY 6 YEARS AFTER TRANSISTORS, IBM INTRODUCED THE SYSTEM 360, AN ALL SOLID STATE TECHNOLOGY COMPUTER. WITH THIS EVENT, GENERATION III CAME ON THE SCENE. WE SHOULD NOTE THAT IN SPITE OF MUCH TALK ABOUT FUTURE GENERATIONS, ESSENTIALLY WE ARE STILL IN GENERATION III HARDWARE AND ARE INVOLVED IN SOLID STATE INTEGRATED CIRCUITRY. THESE NEW COMPUTERS APPROACH NEAR ABSOLUTE RELIABILITY IN TERMS OF THEIR COMPUTING CAPABILITY. OFTEN THE PROBLEMS WITH COMPUTERS ARE NOT IN THE COMPUTER TECHNOLOGY BUT IN THE PERIPHERALS SUCH AS TERMINALS, PRINTERS, ETC. AND THEREFORE THE TOTAL SYSTEM REALIBILITY, ALTHOUGH VASTLY GREATER THAN THAT OF THE EARLY TUBE MODELS, STILL HAS NEED FOR MAINTENANCE AND SERVICE. THE SOLID STATE COMPUTER ALSO DRAMATICALLY INCREASED SPEED IN COMPUTING, IT INCREASED THE CAPACITY OF COMPUTING WHILE DECREASING SIZE AND ALLOWED SIMULTANEOUS OR REALLY NEAR SIMULTANEOUS OPERATION. ADDITIONALLY, SOLID STATE ALLOWED COMPUTERS TO BE NETWORKED OR EXPANDED THROUGH THE ADDITION OF ADDITIONAL MEMORY AND PROCESSING CAPACITY. WITH THE ADVENT OF GENERATION III, COMPUTERS EXPLODED INTO EVERY ASPECT OF HUMAN ENDEAVOR. CASH REGISTERS BECAME COMPUTERIZED. ACCOUNTING PROCESSES AT ALL LEVELS BECAME COMPUTERIZED. MANUFACTURING PROCESSES WERE CONTROLLED BY COMPUTERS AND EVEN HOME ACTIVITIES WERE MANAGED BY COMPUTERS.

SLIDE 8

EIGHTEEN YEARS FROM GENERATION I TO GENERATION III WE TOOK COMPUTERS FROM 30 TON DEVICES OCCUPYING OVER 1500 SQUARE FEET TO APPROXIMATELY 20 POUNDS AND 4 SQUARE FEET FOR THE SAME COMPUTING AND PRINTING CAPABILITY. THE SPEED OF COMPUTERS CHANGED FROM 3 MILLISECONDS PER CALCULATION TO 0.8 OF A MICROSECOND. THIS PHENOMENAL INCREASE IN SPEED COUPLED WITH IMPROVEMENTS SUCH AS MOVING FROM FIXED OR HARD WIRED PROGRAM INSTRUCTIONS TO PROGRAMMABLE MEMORY MADE THE NEW GENERATION OF COMPUTERS HIGHLY FLEXIBLE AND CAPABLE OF PROVIDING INFORMATION NOT ONLY AT A FAST RATE BUT IN VARIED FORM. IN FACT, LOOKING AT A CONSTANT DOLLARD COMPARISON OF THE ORIGINAL VACUUM TUBE COMPUTERS TO THAT OF TODAY'S PROCESSORS, IT HAS BEEN POSSIBLE TO REDUCE COSTS FROM $1.38 PER 100,000 COMPUTATIONS TO 3½¢ FOR THE SAME NUMBER OF COMPUTATIONS. THE PRICE OF ENIAC WAS $400,000 IN 1946 WHILE TODAY THE SYSTEM WITH FULL PERIPHERALS INCLUDING A PRINTER, SCREEN, DISK STORAGE AND CENTRAL PROCESSOR WITH ABOUT THE SAME AMOUNT OF STORAGE CAN BE PURCHASED FOR $3,500.

GENRATION I TO GENERATION III

- 30 TONS & 1500 SQUARE FEET TO 20 POUNDS AND 4 SQUARE FEET
- SPEED FROM 3 MILLISECONDS (3/1,000 OF A SECOND) TO 0.8 MICROSECONDS (0.8/1,000,000 OF A SECOND)
- FIXED PROGRAMS TO PROGRAMMABLE MEMORY
- COST OF $1.38 PER 100,000 COMPUTATIONS TO 3½ CENTS PER 100,000 COMPUTATIONS
- PRICE $400,000 TO LESS THAN $3,500

SLIDE 9

State of the Art

- Large - scale integration (LSI)
  - silicon chips
- Reduced costs
- User friendly
- Networked micro & minis
- Voice activated devices
- Proliferation of software

SLIDE 9

THE CURRENT STATE-OF-ART IN COMPUTERS IS DOMINATED BY THE TECHNOLOGY OF LARGE SCALE INTEGRATION. BASICALLY, THIS IS THE ABILITY TO USE SILICON CHIPS TO REPRESENT COMPLEX ELECTRONIC CIRCUITS WHICH, IN THE PAST, WERE COMPOSED OF MANY TRANSISTORS OR EVEN EARLIER, VACUUM TUBES. THE USE OF SILICON CHIPS WITH THEIR HIGH REALIBILITY AND RELATIVELY LOW COST HAS DRIVEN THE COMPUTER INDUSTRY'S PRICING DOWNWARD. TODAY, RELATIVELY POWERFUL COMPUTERS ARE AVAILABLE FOR SEVERAL THOUSAND DOLLARS. IN FACT, IT IS THE PERIPHERAL ITEMS SUCH AS PRINTERS AND DISPLAY SCREENS WHICH COST MORE THAN THE COMPUTING DEVICE ITSELF. CURRENT STATE-OF-THE-ART ALSO HAS PRODUCED WHAT IS KNOWN AS USER FRIENDLY COMPUTERS. SIMPLY STATED, THIS MEANS THAT THE COMPUTERS CAN BE ADAPTED BY THEIR USERS WITH MINIMAL EFFORTS TO A VARIETY OF TASKS AND CAN BE CONNECTED TO OTHER DEVICES RELATIVELY EASILY. REDUCING THE COMPLEXITY OF KNOWLEDGE NEEDED BY THE USER HAS BEEN A SIGNIFICANT ELEMENT IN THE EXPANSION OF COMPUTERS INTO ALL AREA. A FURTHER CONCEPT WHICH IMPACTS THE COMPUTER WORLD AND THUS ENGINEERING TECHNOLOGY IN EDUCATION IS THE CONCEPT OF NETWORKING MICRO AND MINI COMPUTERS. PRIOR TO THE THIRD GENERALTION COMPUTER, MOST COMPUTING DEVICES WERE MAINFRAME OF LARGE SIZE AND CAPACITY. THESE WERE COMPLICATED MACHINES REQUIRING A GREAT DEAL OF EXPERTISE IN TERMS OF OPERATORS AND SERVICE. TODAY, THROUGH WHAT IS REFERRED TO AS DISTRIBUTIVE PROCESSING, COMPUTER TERMINALS ARE APPEARING THROUGHOUT ALL OF THE WORK ENVIRONMENT AND ARE INTERCONNECTED THROUGH A SERIES OF NETWORKING CONTROLLING COMPUTERS. THIS FACT MAKES COMPUTERS AVAILABLE TO EVERY WORKER IN CERTAIN INDUSTRIES. THIS IS PARTICULARLY TRUE IN THE ENGINEERING AREAS. AN ADDITIONAL ITEM WHICH HAS COME ON THE SCENE IS VOICE ACTIVATED DEVICES. THROUGH

VOICE RECOGNITION TECHNOLOGY AND THE ABILITY TO DIGITIZE HUMAN VOICE INTO ELECTRICALLY READABLE SIGNALS, COMPUTERS NO LONGER HAVE TO DEPEND ON KEYBOARD INPUT. ALTHOUGH KEYBOARDS ARE STILL THE MAJOR WAY OF INPUTING DATA INTO COMPUTER SYSTEMS, MORE AND MORE APPLICATION OF VOICE ACTIVATED DEVICES HAVE COME ON THE SCENE. CURRENTLY WE HAVE A PROLIFERATION OF SOFTWARE. ONE OF THE MAJOR QUESTIONS FACING ALL USERS OF COMPUTERS IS WHAT SOFTWARE OR PROGRAMS SHOULD I PLACE ON MY HARDWARE SYSTEMS. THERE IS SOME TYPE OF SOFTWARE FOR ALMOST EVERY CONCEIVABLE APPLICABLE FROM VIDEO GAMES THROUGH BALANCING CHECKBOOKS THROUGH COMPLETING THE MOST COMPLEX MATHEMATICAL CALCULATIONS. FINDING THE SOFTWARE AND ADAPTING IT TO THE INDIVIDUAL'S USE IS A MAJOR CONSIDERATION IN THE CURRENT STATE-OF-THE-ART SITUATION.

The Future

- Increased speed - Nanoprocessors
  - Layered LSI circuits
- Price reduction stimulates use
- Acceptance as a common necessity

26

SLIDE 10

SLIDE 10

THE FUTURE APPEARS TO BE ONE OF INCREASED SPEED. TODAY WE ARE USE TO TALKING IN TERMS OF MICROPROCESSORS. THE TERM COMES FROM A PROCESSING SPEED IN TERMS OF MICROSECONDS OR ONE-ONE MILLIONTH OF A SECOND. IT IS ANTICIPATED THAT WITHIN A FEW YEARS, NANOPROCESSORS WILL BE ON THE SCENE. THESE PROCESSORS WILL MOVE CALCULATION TIME FROM THE RANGE OF ONE-ONE MILLONTH OF A SECOND TO ONE-ONE BILLIONTH OF A SECOND. IF YOU ARE LIKE ME, IT IS ALMOST IMPOSSIBLE TO IMAGINE A NANOSECOND AND THE IMPACT THAT THIS WILL HAVE ON THE ABILITY OF COMPUTERS TO PROCESS INFORMATION. IT IS ONLY NECESSARY TO SAY THAT A NANOSECOND PROCESSOR WILL BE ONE THOUSAND TIMES FASTER THAN THE FASTEST COMPUTERS WE HAVE AVAILABLE TODAY. THE TECHNOLOGY THAT WILL MAKE THIS POSSIBLE IS LAYERED LARGE SCALE INTEGRATED CIRCUITS. FOR EXAMPLE, DIGITAL TODAY IS PRODUCING 16 LAYERED CIRCUITS AND I HAVE READ OF A 20 LAYERED CIRCUIT BEING USED BY IBM. WHAT THIS DOES IS HAVE THE ELECTRONIC CIRCUITRY MOVE IN A VERTICAL PLANE VERSUS A HORIZONTAL PLANE. THE SIMPLE ACT OF STACKING INCREASES THE SPEED OF PROCESSING BY REDUCING THE DISTANCE IN WHICH A GIVEN ELECTRIC IMPULSE MUST TRAVEL. ALTHOUGH THE TECHNOLOGY IS NOT IMPORTANT TO US IN THIS PRESENTATION, IT IS IMPORTANT TO UNDERSTAND THAT THE FUTURE HOLDS MUCH GREATER POTENTIAL FOR APPLICATION OF COMPUTING DEVICES THAN EVEN YOU AND I CAN IMAGINE TODAY. OF COURSE, INCREASED SPEED WOULD PROBABLY RESULT IN FURTHER PRICE REDUCTION. HOWEVER, A WORD OF CAUTION FOR THOSE WHO ARE WAITING FOR THE PRICE OF COMPUTERS TO COME DOWN. TODAY, IT IS NOT THE INTERNAL COMPUTING DEVICES WHICH APPLY THE MAJOR COST TO A SYSTEM. IN FACT, THE PLASTIC USED IN HOUSING THE COMPUTER, ITS VIEWING SCOPE, PRINTER, ETC. COST MORE

THAN THE CHIPS WITHIN THE SYSTEM. THEREFORE, THERE IS SOME LIMIT AS TO HOW LOW PRICES CAN GET. PARTICULARLY, THE PETROCHEMICAL BASED PLASTICS USED TO HOUSE THE COMPUTERS WILL PROBABLY NEGATE ANY MAJOR FURTHER REDUCTION IN COST. HOWEVER, SOME REDUCTION IN PROCESSOR COST MAY ACT TO STABILIZE THE CURRENT LEVEL OF COST AND WILL PROBABLY RESULT IN INCREASED USE OF THE PRODUCT. FINALLY, THE FUTURE INDICATES THAT COMPUTERS WILL BECOME AN ACCEPTED COMMON NECESSITY JUST LIKE THE TELEPHONE IS TODAY. WE WILL NO MORE THINK OF BEING WITHOUT COMPUTING DEVICES IN ALL ASPECTS OF OUR BUSINESS, EDUCATIONAL, AND PERSONAL LIVES THAN WE WOULD BE WILLING TO WORK WITHOUT TELEPHONE COMMUNICATION TODAY.

SLIDE 11

Educational Implications

- Speciality or discipline studies
- Computer assisted instruction
- Computer managed instruction
- Job application
    - Business applications
    - Allied health and medical
    - Automated office
    - Engineering and industrial technologies

SLIDE 11

AFTER THIS LENGTH DISCUSSION OF COMPUTERS, I WOULD LIKE TO TURN TO SOME EDUCATIONAL IMPLICATIONS. FIRST OF ALL, EDUCATIONAL ENTERED INTO THE WORLD OF COMPUTERS PRIMARILY IN SPECIALTY OR DISCIPLINE STUDIES. THIS SITUATION CONTINUES TODAY. A FULL ARRAY OF DEGREE PROGRAMS IN COMPUTER ENGINEERING ARE AVAILABLE AND THERE ARE MANY DISCIPLINES INCLUDING CHEMICAL ENGINEERING WHICH HAVE DIRECT APPLICATION TO COMPUTER TECHNOLOGY. FURTHER, THERE IS A CORE OF SPECIALTY COURSES AT THE COMMUNITY JUNIOR COLLEGE LEVEL CONSISTING OF COMPUTER PROGRAMMING AND COMPUTER OPERATION WHICH DEALS SPECIFICALLY WITH SKILLS REQUIRED IN COMPUTER APPLICATION. ANOTHER WAY THAT COMPUTERS HAVE IMPACTED EDUCATION IS THROUGH COMPUTER ASSISTED INSTRUCTION. PROGRAMS TO HELP STUDENTS LEARN ENCOMPASS ALL AREAS FROM BASIC SKILL AND REMEDIATION OF DEFICIENCIES THROUGH ADVANCED TECHNOLOGY. GENERALLY, THESE COMPUTER BASED INSTRUCTIONAL PROGRAMS ARE VERY SIMILAR TO EARLIER MANUAL PROGRAMMED TEXTS BUT HAVE THE ABILITY TO GRADE AND CHALLENGE STUDENT RESPONSES ALMOST IMMEDIATELY. I BELIEVE THIS AREA IS ONLY BEING TOUCHED AT THE MOMENT BY EDUCATION AND WE WILL SEE A GREATER EXPANSION OF COMPUTER ASSISTED INSTRUCTION IN THE FUTURE. COMPUTER MANAGED INSTRUCTION IS SOMEWHAT DIFFERENT IN THAT ITS PRIMARY ROLE IS ADMINISTRATIVE. IT KEEPS RECORDS ON STUDENTS, MAKES ASSIGNMENTS, EVALUATES VARIOUS INPUTED INFORMATION, ETC. THERE IS LIMITED USE OF THIS THROUGHOUT THE COMMUNITY COLLEGE SYSTEM OTHER THAN IN THE FORM OF ON-LINE STUDENT RECORDS. THE CONCEPT I AM TALKING ABOUT IS MORE APPLICABLE TO CLASSROOM MANAGEMENT VERSUS INSTITUTIONAL MANAGEMENT. FINALLY, THE IMPLICATIONS IN THE AREA OF JOB APPLICATION ARE THE MAJOR CHALLENGE FOR THE FUTURE OF EDUCATION. COMPUTERS ARE ROUTINELY

USED IN EVERY ASPECT OF THE JOB MARKET. COMMUNITY COLLEGES - PARTICULARLY THOSE WITH STRONG TERMINAL OCCUPATIONAL PROGRAMS - HAVE A MAJOR CHALLENGE IN INSURING THAT GRADUATES KNOW HOW TO USE COMPUTERS IN THEIR CHOSEN AREA OF WORK. LISTED ARE JUST A FEW OF THE APPLICATIONS: BUSINESS WITH ITS ACCOUNTING AND FINANCIAL PROGRAMS; ALLIED HEALTH AND MEDICAL WITH EVERYTHING FROM COMPUTERIZED NURSING STATIONS THROUGH RECORDKEEPING IN THE MEDICAL RECORDS DEPARTMENT DEMAND NEW SKILLS; SECRETARIAL SCIENCE PROGRAMS CAN HARDLY AVOID THE EXISTING AND GROWING AUTOMATED OFFICE TECHNIQUES WHICH ARE ALL COMPUTER BASED; AND FINALLY THE MAJOR TOPIC THAT WE WILL BE LOOKING AT IS THE PROLIFERATION OF COMPUTERS IN THE ENGINEERING AND INDUSTRIAL TECHNOLOGIES.

ENGINEERING TECHNOLOGY

- APPLICATION ORIENTED ENGINEERING - INDUSTRIAL SKILLS
  - INCLUDES ABET RECOGNIZED DISCIPLINES
    - MECHANICAL, ELECTRICAL, GRAPHICS, INDUSTRIAL, CIVIL
  - ADVANCED INDUSTRIAL & MANUFACTURING PROCESSES
    - MACHINE TOOL, INDUSTRIAL ELECTRONICS, INSTRUMENTATION

- COMMUNITY COLLEGE PROGRAMS
  - ASSOCIATED DEGREE
    - OFTEN 2 + 2 ARTICULATED
  - SHORT UPGRADING COURSES/PROGRAMS
    - PROVIDES SKILL UPDATING

- INDUSTRIAL EMPLOYMENT PATTERNS
  - LABORATORY ACTIVITIES
  - ENGINEERING SUPPORT FUNCTIONS
  - FIELD AND INDUSTRIAL APPLICATIONS
  - DESIGN APPLICATION AND PROCESS MODIFICATIONS
  - TROUBLESHOOTING AND MAINTENANCE

32

SLIDE 12

SLIDE 12

FIRST OF ALL, LET ME TAKE A MOMENT TO DEFINE ENGINEERING TECHNOLOGY. FOR THE PURPOSE OF THIS PRESENTATION, WE WILL LOOK AT ENGINEERING TECHNOLOGY AS APPLICATION ORIENTATION ENGINEERING AND INDUSTRIAL SKILLS. INCLUDED UNDER THIS LARGE UNBRELLA ARE THOSE THINGS ACCREDITED OR RECOGNIZED BY THE AMERICAN BOARD OF ENGINEERING TECHNOLOGY SUCH AS MECHANICAL, ELECTRICAL, ENGINEERING GRAPHICS, INDUSTRIAL ENGINEERING, CIVIL ENGINEERING TECHNOLOGY PROGRAMS. ALSO INCLUDED ARE THOSE ADVANCED INDUSTRIAL AND MANUFACTURING PROCESSES WHICH ARE BEING HEAVILY IMPACTED BY ADVANCED TECHNOLOGY. INCLUDED WOULD BE MACHINE TOOL TECHNOLOGY, INDUSTRIAL ELECTRONICS AND THE AREA OF INSTRUMENTATION OR PROCESS CONTROL TECHNOLOGY. IN THE COMMUNITY COLLEGE, ENGINEERING TECHNOLOGY DISCIPLINES GENERALLY TAKE THE FORM OF TWO DELIVERY SYSTEMS. ONE IS THE ASSOCIATED DEGREE WHICH IS DESIGNED TO BE A TERMINAL DEGREE. HOWEVER, MANY OF THESE, PARTICULARY IN THE ABET ARENA ARE ARTICULATED 2 + 2 PROGRAMS IN WHICH THE INDIVIDUAL COMPLETES MOST OF HIS OR HER TECHNICAL EDUCATION AT THE COMMUNITY COLLEGE AND THEN CAN TRANSFER AS JUNIOR STATUS TO COMPLETE SUPPORTING GENERAL EDUCATION AT A SENIOR INSTITUTION. THE OTHER FORMAT IS IN SHORT SKILL UPGRADING COURSES. OFTEN THESE ARE OFFERED BY CONTINUING EDUCATION DIVISIONS IN THE MODE OF TAILORED TRAINING TO MEET A SPECIFIC INDUSTRIAL REQUIREMENT. THEIR OBJECTIVE IS TO PROVIDE THE EXISTING WORK FORCE WITH SKILL UPDATING AS NEW TECHNOLOGY COMES ON THE SCENE. PEOPLE IN ENGINEERING TECHNOLOGY ENTER THE WORK FORCE IN SEVERAL EMPLOYMENT PATTERNS. FIRST OF ALL, SOME NUMBERS ENTER LABORATORY TYPE ACTIVITIES WHERE THEY ASSIST THEORETICAL ENGINEERING PERSONNEL IN RESEARCH AND

DEVELOPMENT ACTIVITIES. A GREATER NUMBER PORBABLY ENTER IN ENGINEERING SUPPORT FUNCTIONS SUCH AS PROVIDING ENGINEERING GRAPHIC SUPPORT TO LARGE CONSTRUCTION AND ENGINEERING FIRMS. AGAIN, THE FOCUS HERE IS IN APPLICATION OF TECHNICAL SKILLS. FIELD AND INDUSTRIAL APPLICATION ALSO FORMS A MAJOR PART OF THE WORK FORCE GRADUATING FROM ENGINEERING TECHNOLOGY PROGRAMS. HERE PEOPLE WORK WITH CONSTRUCTION FIRMS IN SURVEYING AND CONSTRUCTION MANAGEMENT AREAS OR WORKING WITH INDUSTRY IN THE PROGRAMMING OF NUMERIC CONTROLLED DEVICES, ETC. ANOTHER EMPLOYMENT PATTERN INVOLVES THE DESIGN APPLICATION AND PROCESS MODIFICATION. THIS PARTICULARLY IS AN EXPANDING FIELD AS COMPANIES GET INTO THE COMPUTER CONTROLLED MANUFACTURING MODE. FINALLY, MANY PEOPLE TAKING ENGINEERING TECHNOLOGY PROGRAMS END UP AS TROUBLESHOOTERS AND MAINTENANCE PERSONNEL WITHIN INDUSTRY.

- COMPUTER APPLICATION IN ENGINEERING TECHNOLOGIES

  - STANDARD AND SPECIAL PROBLEM SOLVING
  - DATA GATHERING AND ANALYSIS
  - PROCESS CONTROL
  - DESIGN AND MANUFACTURING SUPPORT

35

SLIDE 13

SLIDE 13

How do people in engineering technology use computers? First of all, they use them for standard and special problem solving. A major function of computers is to perform calculations and to manipulate data. During the computing process, an analysis is sometimes performed and results provided the computer operator. Some programs are routine and standard while others have to be modified to meet a specific situation. Another function is data gathering and analysis. Many computers are linked into systems in which they automatically accumulate data, perform certain calculations and provide analysis. The application of this data gathering and analysis function often falls to the engineering technologist. Another aspect is process control, particularly in chemical oriented industries. The closed process is controlled by computers. The design and parameters set by the controlling computers are often problems which are addressed by engineering technologists. Finally, there is the whole field of design and manufacutring support. Computer assisted drafting and computer graphics for example, are applications which are now widespread throughout industry.

SLIDE 14

FACED WITH AN INCREASED USE OF COMPUTERS WITHIN THE ENGINEERING TECHNOLOGY JOB ARRAY, CERTAIN QUESTIONS MUST BE ADDRESSED BY EDUCATION. THESE QUESTIONS INVOLVE PRIMARILY THE APPLICATION IN AN EDUCATIONAL SETTING. ON THIS CHART, I HAVE INDICATED SOME OF THE APPLICATIONS WHICH SEEM ESSENTIAL. FIRST OF ALL, PEOPLE INVOLVED IN ENGINEERING TECHNOLOGY EDUCATION MUST HAVE BASIC COMPUTER SKILLS OR PERHAPS THE TERM COMPUTER LITERACY IS MORE APPLICABLE. THEY MUST KNOW WHAT COMPUTER SYSTEMS ARE CAPABLE OF DOING, THEY MUST BE ABLE TO USE A STRUCTURED PROGRAMMING LANGUAGE, AND THEY MUST BE ABLE TO APPLY THEIR KNOWLEDGE OF COMPUTER SYSTEMS AND PROGRAMMING TO SOLVE STANDARD ENGINEERING PROBLEMS. IN ADDITION, THEY MUST BE ABLE TO APPLY THEIR KNOWLEDGE TO SPECIFIC PROBLEM SOLVING TECHNIQUES AND APPLICATION USES. DURING THIS PORTION OF THEIR EDUCATION, THEY MUST BECOME MORE FAMILIAR WITH THE COMPUTER SYSTEM AND GAIN CONFIDENCE IN THEIR ABILITY TO USE THESE SYSTEMS. A SERIES OF COMPUTATIONAL EXERCISES IS ESSENTIAL AND THEY MUST BE CHALLENGED TO DEVELOP NEW COMPUTER PROGRAMS OR MODIFY EXISTING PROGRAMS TO MEET SPECIFIC REQUIREMENTS. FINALLY, THE APPLICATIONS OF COMPUTERS MUST SIMULATE THE INDUSTRIAL ENVIRONMENT SO THAT A TRANSFERENCE OF LEARNING CAN OCCUR.

SLIDE 14

Educational Application in Engineering Technologies

- Basic Skills or Computer Literacy
  - System capabilities
  - Programming
  - Engineering Applications

- Problem Solving and Applied Uses
  - Familiarity and confidence
  - Computational exercises
  - New and modified programs
  - Industrial simulation

- HARDWARE QUESTIONS
    - MAIN FRAMES, MINIS AND MICROS
    - JOINT USE, NETWORKED OR STAND ALONE
        - OPEN LAB - GENERAL APPLICATION
        - COMPUTER GRAPHICS
        - NUMERIC CONTROL
        - PROCESS CONTROL
    - EDUCATIONAL VERSUS INDUSTRIAL NEEDS

39

- SOFEWARE CONSIDERATIONS
    - LANGUAGE COMPILERS
    - PURCHASED OR DONATED
    - DEVELOPED

SLIDE 15

SLIDE 15

IN MEETING THE DEMANDS FOR ENGINEERING TECHNOLOGY EDUCATION WITH A COMPUTER COMPONENT, SEVERAL QUESTIONS MUST BE ANSWERED BY THE EDUCATORS. FIRST, THERE ARE A SERIES OF HARDWARE QUESTIONS. WHETHER THE INSTITUTION IS GOING TO GO INTO A MAJOR MAINFRAME OR A MINI CONFIGURATION OR HAVE A GROUP OF MICROPROCESSORS IN A NETWORK OR STAND ALONE CONFIGURATION. THE SIZE OF THE INSTITUTION, THE EXTENT OF APPLICATION ALL ENTER INTO THIS DECISION BUT ONCE MADE OFTEN SET THE TONE FOR FUTURE EDUCATIONAL EFFORTS IN THE COLLEGE. FOR EXAMPLE, IF THERE IS A MAJOR INVESTMENT IN A LARGE MAINFRAME COMPUTER THEN TIEING INTO THIS MAINFRAME BECOMES AS ESSENTIAL AS FUTURE DEVELOPMENTS ARE BROUGHT INTO BEING. ANOTHER DECISION IS WHETHER OR NOT TO ENTER INTO A JOINT USE AGREEMENT WITH SOMEONE ELSE WHO OWNS A MAJOR MAINFRAME. AT GREENVILLE TECHNICAL COLLEGE, WE ACCESS THE CLEMSON UNIVERSITY COMPUTER FOR EDUCATIONAL PURPOSES AND A STATE OWNED COMPUTER FOR BOTH EDUCATIONAL AND ADMINISTRATIVES PURPOSES. WE SHARE THESE COMPUTERS AS IT WERE, WITH OTHER USERS. OTHER CONSIDERATIONS ARE SUCH THINGS AS NETWORK OR STAND ALONE APPLICATION. NETWORK APPLICATIONS ALLOWS MORE FLEXIBILITY WHILE STAND ALONE PROVIDES A BETTER DEDICATED LABORATORY. OF COURSE, SOME OF THE ITEMS IMPACTING ON DECISIONS WILL BE WHETHER OR NOT THE INSTITUTION IS OPERATING AN OPEN GENERAL APPLICATIONS LABORATORY OR IS INTERESTED IN SOME SPECIFIC APPLICATIONS SUCH AS COMPUTER GRAPHICS OR NUMERIC CONTROL PROGRAMMING FOR MACHINE TOOL STUDENTS OR THE AREA OF INSTRUMENTATION PROCESS CONTROL. SINCE EACH ONE OF THESE APPLICATIONS HAS CERTAIN PARAMETERS, IT MAY BE NECESSARY TO HAVE A WIDE ARRAY OF EQUIPMENT RANGING FROM JOINT USE MAINFRAMES

THROUGH STAND ALONE MICROPROCESSORS. ONE WORD OF CAUTION. REMEMBER THAT THE INSTITUTION IS IN AN EDUCATIONAL MODE, NOT AN INDUSTRIAL MODE. OFTEN INDUSTRY THROUGH ADVISORY COMMITTEES, PUT GREAT PRESSURE ON SCHOOLS TO OBTAIN COMPLEX INDUSTRIAL ORIENTED COMPUTER EQUIPMENT. OFTEN THE CAPACITY OF THE EQUIPMENT FAR EXCEEDS THE ABILITY OF THE SCHOOL TO PROVIDE EDUCATION AND TRAINING. IF WE EXAMING OUR CURRICULA, WE WILL FIND THERE IS MINIMAL TIME IN WHICH THE STUDENTS WILL BE INVOLVED WITH THE COMPUTER AND THE PROBLEMS THEY GENERALLY SOLVE ARE SMALLER IN SCOPE. FOR EXAMPLE, I MUST CONTINUALLY REMIND MY ENGINEERING GRAPHICS DEPARTMENT THAT WE WILL NOT DESIGN A MAJOR INDUSTRIAL COMPLEX SUCH AS DANIEL OR SIRRINE ENGINEERING WILL AND THEREFORE AS MUCH AS I WOULD LIKE TO HAVE A LARGE POWERFUL SYSTEM SUCH AS THESE TWO MAJOR CORPORATIONS HAVE, WE CAN SETTLE FOR A LESSER SYSTEM WHICH PROVIDES SIMILAR INDUSTRIAL APPLICATIONS EXPERIENCE TO THE STUDENT. PERHAPS PRIOR TO REACHING HARDWARE DECISIONS, ONE SHOULD CONSIDER SOFTWARE. IT WILL HAVE TO BE DETERMINED WHAT TYPE OF LANGUAGE COMPILERS WILL BE NEEDED, WHETHER OR NOT THE SOFTWARE WILL BE PURCHASED OR DONATED, OR WHETHER THE INSTITUTION WILL DEVELOP ITS OWN SOFTWARE. THE LATTER APPROACH IS OFTEN COSTLY AND "CANNED" SOFTWARE EITHER PURCHASED OR DEVELOPED IS OFTEN A BETTER APPROACH. IN TERMS OF LANGUAGE APPLCIATION, AT LEAST IN ENGINEERING TECHNOLOGY, THREE LANGUAGES SHOULD BE CONSIDERED. BASIC, FORTRAN, AND PASCAL. AFTER MUCH STUDY, WE HAVE DETERMINED THAT, IN FACT, THE INDUSTRY IS QUITE SATISFIED IF THE STUDENTS ARE COMPETENT IN ONE OF THESE LANGUAGES. IN FACT, DURING THE TRAINING PROCESS, IT IS NOT POSSIBLE TO PROVIDE ENOUGH IN DEPTH TRAINING TO INSURE PROFICIENCY IN ALL THREE. MY PERSONAL SUGGESTION WOULD BE THAT THE INSTITUTION STAY WITH BASIC LANGUAGE.

The Engineering Technology Faculty

- Knowledge and ability - how good is it?
  - Academic background
  - Industrial experience
  - Recent involvement

- Selling the idea
  - Recognizing the need
  - Change is threatening
  - Change is work

- Developing skills - professional development
  - External short courses or lighting a fire
  - Hardware availability
  - In-house workshops and self-teaching
  - Return to industry

42

SLIDE 16

SLIDE 16

PROBABLY MORE CRITICAL TO AN INSTITUTION THAN QUESTIONS OF HARDWARE AND SOFTWARE ARE THE QUESTIONS CONCERNING THE FACULTY'S ABILITY TO TEACH IN THE NEW COMPUTER ENVIRONMENT. IN PARTICULAR, WHEN LOOKING AT THE ENGINEERING TECHNOLOGY FACULTY, SOME ISSUES WHICH MUST BE CONSIDERED ARE THE KNOWLEDGE AND ABILITIES OF THE FACULTY IN RELATIONSHIP TO COMPUTER APPLICATION. NOT ONLY MUST THE FACULTY HAVE SOME ACADEMIC BACKGROUND IN COMPUTER APPLICATIONS BUT THE FACULTY SHOULD KNOW FROM INDUSTRIAL EXPERIENCE HOW COMPUTERS ARE USED IN THEIR PARTICULAR DISCIPLINE. THIS KNOWLEDGE MUST BE OF A RECENT VINTAGE. REMEMBER, WE ARE WHERE WE ARE TODAY IN COMPUTERS IN ROUGHLY 25 YEARS. THE CHANGE BETWEEN 1946 AND 1982 HAS BEEN AT AN EXPEDIENTIAL RATE NOT A LINEAR RATE. EXPERIENCE THAT'S ONLY FIVE OR SIX YEARS OLD IS GREATLY OUT-OF DATE-NOW. I WOULD STRONGLY SUGGEST THAT IF YOU LOOK AT THE QUALIFICTIONS OF YOUR ENGINEERING TECHNOLOGY FACULTY, YOU WILL FIND THAT THEY ARE NOT COMPETENT TO TEACH COMPUTER APPLICATIONS TO THEIR STUDENTS. WHEN I ARRIVED AT GREENVILLE TECHNICAL COLLEGE, I DISCOVERED THAT EACH ENGINEERING STUDENT WAS REQUIRED TO TAKE ONE COURSE IN FORTRAN PROGRAMMING. IN REVIEWING THE CREDENTIALS OF THE FACULTY, I FOUND NO ONE WHO WAS A PERMANENT FACULTY MEMBER WHO COULD TEACH FORTRAN PROGRAMMING OR KNEW HOW TO WRITE A FORTRAN PROGRAM. IN SHORT, WE WERE REQUIRING STUDENTS TO LEARN SOMETHING WE OURSELVES DID NOT KNOW HOW TO DO. I'LL SUBMIT THIS IS NOT A UNIQUE SITUATION. IF, AS I SUSPECT, THE KNOWLEDGE AND ABILITY OF THE FACULTY IS LESS THAN DESIRED, THE NEXT ISSUE BECOMES ONE OF SELLING THE IDEA OF UPGRADING THEIR COMPETENCE. PERHAPS THE FIRST STEP IS FOR THE FACULTY TO RECOGNIZE THE NEED. I

DO NOT BELIEVE THIS IS A MAJOR CHALLENGE IF THE ADMINISTRATION WILL INVOLVE THE FACULTY IN EXPLORING THE FACTS OF COMPUTER APPLICATION IN INDUSTRY. I THINK WITHIN A SHORT PERIOD OF TIME THE FACULTY WILL RECOGNIZE THAT COMPUTER APPLICATIONS MUST BE AN INTEGRAL PART OF THEIR CURRICULUM. HOWEVER, RECOGNIZING THIS, WE ARE STILL FACED WITH THE NEGATIVE ASPECTS OF CHANGE. FIRST OF ALL, CHANGE IS THREATENING TO THE EXTENT THAT INDIVIDUALS MUST LEARN NEW SKILLS. FACULTY MEMBERS, FOR EXAMPLE SOME OF OUR STAFF RECEIVED THEIR DEGREES IN THE LATE 30'S AND EARLY 40'S, HAVE NO UNDERSTANDING OF COMPUTER APPLICATIONS. TO LEARN A NEW SET OF SKILLS SUCH AS COMPUTER PROGRAMMING IS A MAJOR THREAT. SOMEHOW THIS THREAT MUST BE MITIGATED/DIFFUSED. ANOTHER ASPECT OF CHANGE IS THAT IT IS A WORK PRODUCER. IF YOU ARE TO CHANGE THE CURRICULUM, THE CURRICULUM HAS TO BE REVISED, LESSON GUIDES REWRITTEN, ETC. THIS GENERALLY IS DONE OVER AND ABOVE THE REGULAR WORKLOAD OF THE FACULTY AND THEREFORE CAUSES A RESISTANCE TO IMPLEMENTATION OF NEW DATA INTO PROGRAMS. SOME OF THE TECHNIQUES THAT ARE AVAILABLE IN OVERCOMING THE NEGATIVE ASPECTS OF CHANGE ARE THE PROFESSIONAL DEVELOPMENT EFFORTS OF THE INSTITUTION. A MODEL THAT WE HAVE FOUND AT GREENVILLE TECHNICAL COLLEGE TO BE VERY USEFUL IS ONE WHICH INVOLVES FIRST, PROVIDING FACULTY THE OPPORTUNITY TO ATTEND EXTERNAL SHORT COURSES IN COMPUTER PROGRAMMING. IN OUR CASE, WE USE COURSES AT CLEMSON UNIVERSITY AND THE UNIVERSITY OF SOUTH CAROLINA. THESE TWO AND THREE DAY COURSES ALLOWED FACULTY MEMBERS TO BECOME ACQUAINTED WITH SIMPLE COMPUTER PROGRAMMING AND DIFFUSED MUCH OF THEIR CONCERNS OVER THEIR ABILITY TO HANDLE THE NEW SKILLS. IN FACT, THESE COURSES STIMULATED THE FACULTY MEMBERS IN A DESIRE TOWARDS LEARNING MORE ABOUT COMPUTERS. MANY FACULTY MEMBERS, AS A RESULT OF THESE SHORT COURSES, PURCHASED THEIR OWN PERSONAL COMPUTERS FOR HOME USE. THE EXTERNAL SHORT

COURSES THEN REALLY SERVED AS THE CATALYST TO START A DIALOGUE ON WAYS TO INTEGRATE COMPUTER APPLICATION INTO OUR PROGRAMS. ONCE THIS WAS DONE, IT WAS ESSENTIAL THAT HARDWARE BECOME AVAILABLE TO THE FACULTY. NOTHING IS MORE COUNTERPRODUCTIVE THAN TO STIMULATE THE FACULTY AND THEN PROVIDE THEM NO MEANS FOR CONTINUING THE EXPLORATION. BEFORE GETTING TOO DEEPLY INVOLVED IN REORIENTING THE FACULTY, A FIRM COMMITMENT HAS TO BE MADE ON HARDWARE AND ITS AVAILABILITY FOR BOTH TEACHING STUDENTS AND FOR STAFF DEVELOPMENT. WITH HARDWARE AVAILABILITY, THE INSTITUTION CAN SET UP IN-HOUSE WORKSHOPS TO QUALIFY OTHER FACULTY MEMBERS AND PROVIDE A MECHANISM OF COMPUTER BASED TUTORIAL SESSIONS IN WHICH INDIVIDUALS CAN LEARN MORE ABOUT PROGRAMMING AND COMPUTER APPLICATIONS. IN ADDITION, THE AVAILABILITY OF HARDWARE ALLOWS THE INSTRUCTORS TO TEST VARIOUS PROBLEM SITUATIONS THAT WILL BE PRESENTED TO STUDENTS. ALL IN ALL, THE INITIAL CONTACT WITH PROGRAMMING, AVAILABILITY OF HARDWARE AND THE EXPANSION OF SKILLS THROUGH IN-HOUSE TRAINING WILL BRING MOST FACULTY TO AT LEAST A MINIMUM LEVEL OF COMPETENCE. HOWEVER, IF WE TRULY BELIEVE WE ARE PREPARING OUR STUDENTS FOR THE WORLD OF WORK, THEN OUR FACULTY MUST UNDERSTAND THIS WORLD. THEREFORE, REGULAR RETURN TO INDUSTRY WHERE THE FACULTY MEMBER CAN GAIN EXPERIENCES ASSOCIATED WITH COMPUTER APPLICATION IN THEIR DISCIPLINE IS ESSENTIAL. I WOULD SUGGEST THAT FOR OCCUPATIONALLY ORIENTED PROGRAM A STAFF/ FACULTY DEVELOPMENT MODEL WHICH DOES NOT INCLUDE A SIGNIFICANT RETURN TO INDUSTRY ELEMENT IS NEAR USELESS. AFTER ALL, WE ARE NOT TRAINING TOWARDS SOME ACADEMIC IDEAL BUT TOWARDS THE PRACTICAL APPLICATION OF SKILLS IN A RATHER HOSTILE WORK ENVIRONMENT WHERE PERFORMANCE IS CRITICAL TO SUCCESS.

SLIDE 17

I WOULD LIKE TO TOUCH FOR A MOMENT ON CURRICULUM DEVELOPMENT. FIRST OF ALL, ANY DEVELOPMENT OF CURRICULUM REQUIRES SOME MECHANISM FOR APPROVING THE DIRECTION IN WHICH THE CURRICULUM WILL BE MODIFIED. A SYSTEM WHICH IDENTIFIES THE ASPECTS OF REVISION IS A CENTRAL ELEMENT. ONCE IT HAS BEEN DETERMINED WHAT WILL BE TAUGHT, THEN ACTIVITIES SUCH AS NEW COURSES WILL HAVE TO BE DEVELOPED, IF APPROPRIATE, AND EXISTING COURSES UNDOUBTEDLY WILL REQUIRE REVISION. BASED ON OUR EXPERIENCE, I WOULD SUGGEST THAT ANY ENGINEERING TWO YEAR PROGRAM CONTAIN A TWO COURSE MINIMUM CONTENT. FIRST, ALL STUDENTS SHOULD GO THROUGH AN INTRODUCTION AND ELEMENTARY PROGRAMMING COURSE. THIS COURSE WILL TEACH THEM ABOUT COMPUTER CAPABILITIES IN GENERAL AND HOW TO PREPARE SIMPLE STRUCTURED PROGRAMS IN ONE OF THE APPLICABLE LANGUAGES. NEXT, THERE SHOULD BE A COURSE FOR THOSE INDIVIDUALS IN ENGINEERING TECHNOLOGY COURSES SUCH AS ELECTRICAL, MECHANICAL AND INDUSTRIAL. THIS COURSE SHOULD BUILD ON THE INTRODUCTORY AND INTRODUCE ENGINEERING PROBLEM SOLVING USING THE COMPUTER. DURING THIS COURSE, THE INDIVIDUALS WILL STRENGTHEN THEIR PROGRAMMING SKILLS AND LEARN HOW TO SOLVE TYPICAL PROBLEMS USING A COMPUTER. FOR THOSE INDIVIDUALS WHO ARE PURSUING SPECIALIZED CURRICULUMS SUCH AS ENGINEERING GRAPHICS, NUMERIC CONTROL PROGRAMMING, ETC., SPECIAL APPLICATION COURSES ARE REQUIRED. FOR EXAMPLE, IN ENGINEERING GRAPHICS, A COMPUTER ASSISTED DRAFTING COURSE SHOULD BE INCLUDED. FOR THOSE IN METALWORKING, NUMERIC CONTROLLED PROGRAMMING SHOULD BE INTRODUCED. ALL COURSES SHOULD HAVE AS AN INTEGRAL PART OF THEIR ACTIVITIES, LABORATORY EXERCISES WHICH REQUIRE THE USE OF THE COMPUTER. FOR EXAMPLE, CERTAIN PROBLEMS INVOLVING STRESS ANALYSIS CAN BE GIVEN TO MECHANICAL ENGINEERS WHICH REQUIRE THEM TO GO INTO THE COMPUTER

LAB AND USE A PROGRAM IN SOLVING THE PROBLEM. ON TOP OF THE TWO COURSE MINIMUM WITH SUPPORTING PROJECTS I.. VARIOUS LABORATORY COURSES, I WOULD SUGGEST ADVANCED APPLICATION OF COMPUTERS IN ENGINEERING TECHNOLOGY IS REQUIRED. THESE COURSES COULD BE ELECTIVE IN NATURE AND OFTEN ORIENTED TOWARDS UPGRADING INDIVIDUALS ALREADY IN INDUSTRY. COMPUTER ASSISTED NUMERIC CONTROL PROGRAMMING AND ADVANCED COMPUTER GRAPHICS ARE TWO EXAMPLES OF THE TYPE COURSES THAT SHOULD BE CONSIDERED.

SLIDE 18

WELL, I HAVE TAKEN QUITE A BIT OF TIME TO TRY TO EXPLAIN WHAT HAS OCCURRED IN THE WORLD OF COMPUTERS AND HOW THOSE OCCURRENCES HAVE IMPACTED THE EDUCATION DELIVERED BY OUR COMMUNITY COLLEGES, IN PARTICULAR THAT IN THE AREA OF ENGINEERING TECHNOLOGY. IN SUMMARY I WOULD LIKE TO SAY THAT ONLY 25 YEARS AGO WE WERE AT A STAGE WHERE COMPUTERS WERE A NOVELTY. THEY WERE USED IN SPECIALIZED APPLICATIONS AND EDUCATORS DID NOT HAVE TO CONCERN THEMSELVES WITH THE IMPLICATIONS OF THE TECHNOLOGY. TODAY WE FIND COMPUTERS SPREAD INTO ALL AREAS OF OUR DAILY LIVES. THEY ARE AN INTEGRAL PART OF THE HIGH TECHNOLOGY FIELDS FOR WHICH WE ARE TRAINING TECHNICIANS. THERE IS AN INCREASE IN DISTRIBUTIVE PROCESSING WHICH SIMPLY MEANS THAT EVERYONE HAS ACCESS TO A COMPUTER TERMINAL. IN THE FUTURE, WE ARE GOING TO SEE FASTER, SMALLER AND MORE POWERFUL COMPUTERS AND AN INCREASED PROLIFERATION OF COMPUTER APPLICATIONS AS A RESULT. COMPUTERS WILL BE USED IN EVERY ASPECT OF THE TECHNOLOGIES AND IT IS ABSOLUTELY ESSENTIAL THAT OUR TRAINING PROGRAMS REFLECT THIS FACT.

- Curriculum Development
  - Requires a planned approval
  - New courses needed
  - Revision of existing courses
  - Suggested content -2 course minimum
    - Introduction & Programming - all students
    - Problemsolving application - pure engineering
    - Special application - allied curriculum
    - Laboratory projects - all courses
    - Advanced applications - elective and upgrading

64

62

63

SLIDE 17

SUMMARY

- WHERE WE WERE
  - SPECIALIZED APPLICATION AND LIMITED AVAILABILITY

- WHERE WE ARE
  - WIDESPREAD USE IN ALL AREAS
  - INCREASED DISTRIBUTIVE PROCESSING

- WHERE WE WILL BE
  - FASTER, SMALLER AND MORE POWERFUL UNITS
  - AVAILABLE AND USED IN EVERY ASPECT OF THE TECHNOLOGIES

SLIDE 18

Major Questions for Education

- What kind of training?
- On what kind of equipment?
- With what degree of faculty competence?

SI

SLIDE 15

SLIDE 19

COMPUTERS, WHETHER IT BE ENGINEERING TECHNOLOGY OR BUSINESS APPLICATIONS OR ALLIED HEALTH APPLICATION, HOLDS SOME KEY QUESTIONS FOR EDUCATORS. AS WE LOOK AT THE WORLD OF WORK AND THE IMPACT OF COMPUTERS, WE MUST DETERMINE WHAT KIND OF TRAINING IS REQUIRED. ONCE WE KNOW THAT, WE ARE GOING TO HAVE TO DEAL WITH THE ISSUE OF WHAT EQUIPMENT IS NECESSARY TO DO THE TRAINING. AND FINALLY, AND PROBABLY MOST IMPORTANT, WE WILL NEED TO DEAL WITH THE QUESTIONS OF FACULTY COMPETENCE AND THEIR ABILITY TO TEACH THE SKILLS NEEDED BY OUR GRADUATES.

THANK YOU!

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